

Application No.: 10/669,621  
Amendment dated: October 25, 2005  
Reply to Office Action dated: July 25, 2005

### REMARKS/ARGUMENTS

In the Preliminary Amendment, Applicant did not properly identify the claims. Only claims 1 and 2 were in the case previously. Therefore, claims 8-14 are now identified as claims 3-9. Claims 1-2 remained cancelled.

### Specification

The specification was objected to by the Examiner because Applicant did not submit a marked-up copy of the substitute specification. A substitute specification and abstract have been submitted with a marked-up version and a clean version to comply with the Examiner's request. No new matter has been introduced by the substitute specification.

For all the above reasons, the Applicant respectfully submits that this application is in condition for allowance. A Notice of Allowance is earnestly solicited.

The Examiner is invited to contact the undersigned at (408) 975-7500 to discuss any matter concerning this application.

The Office is hereby authorized to charge any additional fees or credit any overpayments under 37 C.F.R. §1.16 or §1.17 to Deposit Account No. 11-0600.

Respectfully submitted,

KENYON & KENYON

Dated: October 25, 2005

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## AMENDMENT TO THE SPECIFICATION

### POLISH CLEANING APPARATUS AND METHOD IN MANUFACTURE OF HGA

#### Related Application

[0001] This application is a Divisional of Patent Application 09/810,833 filed on March 16, 2001 and issued as patent number 6,645,308 on November 11, 2003.

#### FIELD OF THE INVENTION

[0002] The present invention relates generally to a polish-cleaning cleaning and polishing apparatus and a polish-cleaning method used in the disk drive industry, industry, and more specifically to a polish-cleaning apparatus and a polish-cleaning method adapted to be, used in the manufacture of a HGA (head gimbal assembly) More specifically, the present invention relates to a cleaning and polishing apparatus and method used in the manufacture of a head gimbal assembly.

#### BACKGROUND OF THE INVENTION

[0003] ~~As well known in that, thin~~ Thin film heads are used with data storage disks for reading or writing data ~~on~~ onto a recording layer of a data storage disk. Typically, the head "flies" above the surface of the disk at a very low "altitude". The height of the air gap between the head and the disk is usually measured in fractions of ~~micron so that~~ of a micron. The low height of the air gap causes an air bearing is formed. to be formed.

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[0004] ~~For disks storing~~ For a disk that stores data using magnetic effects, the head usually includes ~~an RF~~ a radio frequency coil for transmitting and receiving a magnetic field to write and read in the recording layer. For disks storing ~~that store~~ data using optical effects, the head ~~can include~~ may include an objective lens to focus a light beam at the recording layer.

[0005] ~~With low flying heads, dust in the environment is a serious problem. Dust particles can cause catastrophic "head crashes" destroying the head and disk. Also, significant amounts of dust can accumulate on the head to interfere with the magnetic or optical effects.~~ Along with the evolution of the disk industry, the surface cleanliness of read-write heads has become one of the most critical ~~concerns,~~ concerns, ~~because contaminants may cause a disk driver malfunction or even fail to spin up, while classical wash, rinse and dry technology using an aqueous chemical substance and ultrasonic agitation can not provide adequate cleaning efficiency for a head's ABS surface. The manufacturers are trying their best to seek more effective contamination removal methods to ensure that components and drives always remain as clean as possible.~~ With low-flying heads, dust in the environment is a serious problem. Dust particles can cause catastrophic "head crashes" destroying the head and disk. Also, significant amounts of dust can accumulate on the head to interfere with the magnetic or optical effects. Contaminants may cause a disk driver to malfunction or even fail to spin up.

[0006] Classical wash, rinse and dry technology using an aqueous chemical substance and ultrasonic agitation can not provide adequate cleaning efficiency for a head's air bearing surface. More effective contamination removal methods to ensure that components and drives

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always remain as clean as possible are needed.

**[0007]** US Patent No. 5,467,238 issued to Neville K. Lee et al on November 14, 1995, disclosed a cleaning apparatus for cleaning ~~[[a]]~~ read/write head heads used for accessing data stored on a recording disk of a disk drive. The cleaning apparatus ~~comprises~~ had a mounting base positioned adjacent to the disk. The base includes a ratchet mechanism for rotating a cleaning pad mounted thereon. ~~The mechanism is activated by a~~ The rotary or linear actuator arm ~~for positioning~~ used to position the read/write head activates the ratchet mechanism. The ratchet mechanism rotates the cleaning pad while the actuator unloads the read/write head from the disk. A loading ramp is used to vertically position the read/write head relative to a cleaning surface of the cleaning pad. ~~However, since this~~ This conventional cleaning apparatus is more complicated in structure, lower in efficiency, and is used only after assembly of a disk drive, ~~it is not suitable for~~ making it unsuitable for use in the mass production of the heads.

## **SUMMARY OF THE INVENTION**

**[0008]** ~~One object of the present invention is to provide a new kind of polish cleaning apparatus~~ A new kind of cleaning and polishing apparatus and method for cleaning the heads of a HGA (head gimbal assembly) ~~so that the problem of~~ to eliminate contamination of the heads by dusts or particulates ~~can be completely overcome.~~ is disclosed. ~~Another object of the present invention is to provide a polish cleaning method adapted to the apparatus.~~ In accordance with one aspect of the present invention, a polish cleaning and polishing apparatus for cleaning ~~an HGA in a head~~ may have ~~comprises: a frame;~~ a frame, a plurality of carriers for

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locating and holding a plurality of HGAs, respectively, ~~said HGAs having a face, a slider ABS surface, to be polished, directed downwards;~~ a plurality of polish fingers under the carriers~~[[.]]~~ and fixed on a loading base; base, a cloth attached to said polish fingers as a polish medium to provide a plurality of polish surfaces, on which the HGAs are polish cleaned; fingers, and a plurality of press-pins on each of the carriers, ~~pressing on a HGA's flexure, respectively, to provide proper friction between the slider ABS surface and the polish surface.~~ The HGAs may have a face and a slider with an air-bearing surface (ABS) to be polished and directed downwards. The cloth may act as a polish medium to provide a plurality of polish surfaces on which the HGAs are polished and cleaned. The press pins press on a HGA's flexure to provide proper friction between the slider ABS and the polish surface.

[0009] According to another embodiment, a pneumatic cylinder unit is combined with the ~~carriers and~~ carriers. ~~[[is]]~~ The pneumatic cylinder unit, controlled by a programmable controller, adapted to bring may move the carriers, as well as the plurality of HGAs, to HGAs. The pneumatic cylinder unit may move back and forth in X and Y directions according to a customized program. The solution may be sufficiently agitated by the motion of a cylinder unit to promote dissolution action. Also, a polish tank containing a cleaning solution, may be provided on the top of the ~~frame, the~~ frame. The cleaning solution is recirculated through a pump and a filter canister with an effective filter cartridge, and cartridge. The filter canister may filter off the insoluble, suspended contaminants and particles in the solution so that the slider ABS will not be re-contaminated. ~~[[a]]~~ A thermostatically controlled strip heater for heating may heat the solution to a desired working temperature. In accordance with another

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~~aspect of the present invention, a polish cleaning method adapted to the apparatus for cleaning a HGA (head gimbal assembly) in a head, comprises the following steps: precisely locating and holding a plurality of HGAs in a carrier, said HGAs having a face, a slider ABS surface, to be polished, directed downwards; scrubbing off contaminants on the dirty slider surface being cleaned by a moving cloth strip, meanwhile smashes mass contaminants into tiny pieces; getting the~~ The contaminants may be scrubbed off into a into the solution through solubilization, emulsification, ~~[[ete-]]~~ chemical action by a detergent, etc. The temperature, kind kind, and concentration of the chemical substance of said solution ~~[[are]]~~ may be selected to achieve maximum cleaning effectiveness; effectiveness. sufficiently agitating the solution to promote dissolution action by the motion of a cylinder unit; filtering off the insoluble, suspended contaminants and particles in the solution by a filter canister in time so that the slider ABS surface will not be re-contaminated. The polish cleaning apparatus and method of the present invention provides much higher cleaning efficiency for visible or invisible contaminants and particulates on a slider ABS surface. The apparatus and method of the invention is so versatile and effective that they are suitable for the removal of dusts, oils, fingerprints, and other organic and inorganic contaminants in the form of both particulate and thin-film.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

**[0010]** The above and other objects and advantages of the present invention will be described by way of preferred embodiments and with reference to the drawings, in which

Figure 1 is a top view of the polish cleaning apparatus of the present invention;

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Figure 2 is a perspective view of an HGA carrier positioned on polish fingers in the polish cleaning apparatus of the present invention; and

Figure 3 is a diagram of water circulation of the polish cleaning apparatus.

#### ~~PREFERRED EMBODIMENTS OF THE INVENTION~~

~~As shown in Figures 1-3, a polish cleaning apparatus of the invention mainly comprises four parts: polish fingers, HGA carriers, a cylinder motion unit and an immersion polish tank.~~

~~With reference to Figure 2, in polish cleaning units 1 and 8 provided are two rows of polish fingers 2 on which a kind of anti-static polyester cloth strip is fixed smoothly by tension force to form a polish cleaning surface, and a plurality of HGAs 1 to be polished effectively are positioned on the polish cleaning surface.~~

~~The HGA carriers are provided with a plurality of cylindrical pressing pins which press on a HGA's flexure, respectively. The HGA carriers hold a plurality of HGA 1 to move back and forth according to a certain program for substantially simultaneously polish cleaning, and also provide precise locations for a plurality of HGA 1 by the co-ordination of the carriers and polish finger, see Figure 2.~~

~~The cylinder motion units each comprise an X-cylinder 4, 5 and a Y-cylinder 3, 6, which move back and forth in X, or Y direction, respectively, according to a certain program customized in advance and bring HGA carriers as well as the plurality of HGA to move in both X and Y~~

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~~directions repeatedly.~~

~~The HGA carriers holding the HGAs are immersed into the polish tank containing a solution so that the HGAs can be polished. The tank has an overflow weir, a pump, and a filter canister~~

~~with a 0.2 micron filter cartridge for solution recirculating and filtering, and it also has a thermostatically controlled strip heater to heat the solution to a proper working temperature.~~

~~The polish cleaning method of the present invention is now explained. The polish is a contact cleaning method using a kind of polyester cloth, which has good anti-static properties, less particle or particle free, wear durability, as a cleaning medium. When the polish cleaning apparatus is operated, the pneumatic cylinder unit brings the HGA being polished to move back and forth in both X and Y directions on the cloth strip wrapped onto the polish fingers, and then the slider ABS surface is polished and much higher cleaning efficiency (nearly 90%) can be achieved. Please refer to Figure 1. The cleaning function is derived from chemical and physical actions, as well as the polish cleaning. It includes three processes:~~

~~Cloth Scrubbing Action is the first process, playing the most primary and important role in polish cleaning. In this process, the moving cloth strip scrubs off contaminants on the dirty slider surface being cleaned, meanwhile smashes mass contaminants into tiny pieces.~~



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~~Detergent Dissolution Action is the second process, in which contaminants scrubbed off get into solution through solubilization, emulsification, etc. chemical action by a detergent. It is similar to a conventional cleaning process: time, temperature, and kind and concentration of the detergent are the three important parameters in achieving maximum cleaning effectiveness. Meanwhile, motion of the cylinder provides sufficient agitation to promote dissolution action.~~

~~Filtration Action is the third process in which the insoluble, suspended contaminants and particles in solution will be filtered off by a filter canister in time, or else, they may re-contaminate the products so that the latter must be cleaned again.~~

### DETAILED DESCRIPTION

[0011] The HGA head gimbal assembly (HGA) is a kind of precise precision component in a disk drive. The conventional ultrasonic cleaning can cause mechanical damage under high ultrasonic power, which limits its application, and can not provide an adequate cleaning effect. However, the new polish cleaning technology can effectively clean the head and does not cause side effects for HGA performance. Basically, the polish cleaning can remove all kinds of contaminants such as dust, particles, film, etc. Its removal efficiency can achieve up to 95% for all kinds of contaminants whether it's organic or inorganic, while the classical ultrasonic cleaning does only about 60% for small particles and is not efficient for other kinds of contaminants.

~~While the present invention has been described by way of the preferred embodiments, the foregoing described is in all aspects illustrative, not restrictive. It is obvious to a person skilled~~

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~~in this art that numerous variations and modifications can be devised without departure from the scope of the invention.~~

[0012] As shown in Figures 1-3, one embodiment of a polishing and cleaning apparatus of the present invention may have polish fingers, HGA carriers, a cylinder motion unit and an immersion polish tank.

[0013] In one embodiment of the present invention, the polishing and cleaning method may be a contact-cleaning process using a type of polyester cloth. The polyester cloth has good anti-static properties having less particles or even being particle-free and has good wear durability as a cleaning medium. A pneumatic cylinder unit may bring the HGA being polished and cleaned into the cleaning area. The pneumatic cylinder unit may move back and forth in both X and Y directions on a cloth-strip wrapped onto a set of polish fingers. The slider air bearing surface (ABS) is polished with a much higher cleaning efficiency (nearly 90%), as shown in Figure 1.

[0014] In one embodiment illustrated by Figure 2, cleaning units 1 and 8 may have two rows of polish fingers 2. On these two rows of polish fingers 2, a kind of anti-static polyester cloth-strip is fixed smoothly by tension force to form a polish cleaning surface. A plurality of HGAs 1 may be positioned on the cleaning surface to be cleaned and polished effectively.

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[0015] The HGA carriers hold a plurality of HGAs 1. The HGA carriers also position the plurality of HGA 1 by the co-ordination of the carriers and polish fingers, see Figure 2. The HGA carriers may have a plurality of cylindrical pressing pins to press on a HGA's flexure. The HGA carriers may move back and forth according to a computer program for substantially simultaneous polishing and cleaning.

[0016] In one embodiment, the cylinder motion units may each comprise an X-cylinder 4, 5 and a Y-cylinder 3, 6. The X-cylinder 4, 5 and Y-cylinder 3, 6 move back and forth in X or Y direction, according to a computer program customized in advance, and cause HGA carriers as well as the plurality of HGAs to move in both X and Y directions repeatedly.

[0017] In one embodiment illustrated in Figure 3, the HGA carriers containing the HGAs may be immersed into a polish tank containing a solution so that the HGAs can be cleaned and polished. The tank may have an overflow weir, a pump, and a filter canister. The filter canister may have a 0.2 micron filter cartridge for solution recirculating and filtering. The tank may also have a thermostatically controlled strip heater to heat the solution to a proper working temperature.

[0018] The cleaning function may have chemical and physical actions, as well as the polish cleaning. A cloth scrubbing action may be performed first. The moving cloth strip scrubs off contaminants on the dirty slider surface being cleaned. This action smashes the

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mass contaminants into tiny pieces.

[0019] The detergent dissolution action may be performed second. The contaminants scrubbed off may be placed into solution through solubilization, emulsification, chemical action by a detergent, etc. As in a conventional cleaning process, time, temperature, and kind and concentration of the detergent may be important parameters in achieving maximum cleaning effectiveness. Motion of the cylinder may provide sufficient agitation to promote dissolution action.

[0020] The filtration action may be performed third. A filter canister may filter off the insoluble, suspended contaminants and particles in solution in time. Otherwise, they may re-contaminate the products so that the latter must be cleaned again.

[0021] While the present invention has been described by way of the preferred embodiments, the foregoing described is in all aspects illustrative, not restrictive. It is obvious to a person skilled in this art that numerous variations and modifications can be devised without departure from the scope of the invention.

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#### Abstract

~~A new polish cleaning apparatus and a cleaning method are described for cleaning an HGA (head gimbal assembly) to meet the increasing requirements for cleanliness of read-write heads in the disk drive industry. The HGA polish cleaning apparatus includes an HGA polish cleaning assembly having a set of HGA carriers for effectively simultaneously polish clean a plurality of HGAs against a back-and-forth moving polish finger wrapped with anti-static polyester cloth. A plurality of HGAs to be polished are simultaneously loaded into the HGAs carriers which are then immersed in a polish cleaning tank containing a solution. The HGA carriers are driven by a pneumatic cylinder unit which is individually controlled by a programmable controller for exact polish cleaning. It also has a plurality of press pins to fix the HGAs and supply proper friction between the slider ABS surface and the polish surface. The polish cleaning tank has an overflow weir, a pump, and a filter canister with a 0.2-micron filter cartridge for solution recirculation and filtering, it also has a thermostatically controlled strip heater to heat the solution to a good condition.~~

#### ABSTRACT

A method and apparatus for cleaning the slider air bearing surface of a head gimbal assembly is disclosed. A plurality of carriers may position and hold a plurality of head gimbal assemblies to be polished. A cloth strip may be rubbed against the slider air surface. A movable cylinder unit coupled to the plurality of carriers may move the carriers. A polish tank may provide cleaning solution to the movable cylinder unit. A pump may recirculate the cleaning solution. A filter canister with a filter cartridge may filter the cleaning solution.